Dwarfism in Beef Cattle

by E W. Stringam*

DWARF-LIKE forms have been observed in man and animals for centuries. Many of these forms have been hereditary. It is now believed by several scientists that some of our domestic breeds or strains of pets may be deliberate attempts to propagate these forms. Indeed one of the earliest references to cattle dwarfs is a report of such a breed. Charles Darwin, writing in his diary during a trip around the world in 1883 makes this observation while in South America:

"On two occasions, I met with in this province some oxen of a very curious breed, called Nata or Niata. They appear externally to hold nearly the same relation to other cattle, which bull or pug dogs do to other dogs. Their forehead is very short and broad, with the nasal end turned up, and the upper lip much drawn back; their lower jaws project beyond the upper, and have a corresponding upward curve; hence their teeth are always exposed. Their nostrils are seated high up and are very open; their eyes project outwards. When walking they carry their heads low, on a short neck; and their hinder legs are rather long compared with the front legs than is usual. Their bare teeth, their short heads, and upturned nostrils give them the most ludicrous self-confident air of defiance imaginable." (1).

The strain was reported to be some 80 - 90 years old at that time.

There is the greatest similarity, from his description, between these animals and what are affectionately termed "snorter" dwarfs in this country.

FORMS OF DWARFISM

The most frequent question asked by breeders not familiar with dwarfs is, what do they look like? This question cannot be answered simply for the forms of the known types show great variation. Most of the types which occur naturally in our cattle population, however, might be classified in three general groups. This grouping is based primarily on the outward appearance of most of the forms found in our Manitoba study and by fitting those described by other research workers into these groups.

(a) "Snorters" — This is not the name that is always used by the geneticist or physiologist but it the one most commonly used by breeders since heavy and labored breathing is a very audibly apparent characteristic.

These animals are short and compact at birth and stockmen seing them for the first time will often surmise that they have a promising show winner. The fore limbs are abnormally short. The head may be overly square and the lower jaw slightly protruding; there is frequently a bulging or prominent forehead. The tip of the tongue usually protrudes and the eyes are bulging. Some or all of these head features may be missing in the new-born. In fact, in the odd "snorter" the head is rather long and sometimes narrow.

Still-borns are common, particularly among first calf heifers which may have difficulty delivering the calf. Frequently the live calf cannot rise and has difficulty in co-ordinating locomotion, due to either shortened or overly flexed tendons and a faulty equilibrium. Deaths are frequent in the early days of life of these creatures.

As the calf grows the differences between the dwarf and a normal become more apparent. A peculiar stance is taken up, the paunch becomes distended, the breathing heavier and bloat is common. The limbs take on a sort of permanently emaciated condition especially after the calf is weaned. The

*Division of Animal Science, University of Manitoba.
Presented before Canadian Veterinary Medical Association.

shortening of the limbs and thickness is disproportionate and the head is overly large for the body. At three years of age they approach 1/3 to 2/3 normal weight but appear very old. They are usually typical cretins and bear a somewhat similar relationship to normal cattle as the victims of Hurlers Syndrome do to normal humans.

However, in some modified versions of this form, two of which are present in our Manitoba herd, some or all of these more grotesque features are missing.

This is, however, the form most frequently observed in the Hereford and the form most frequently observed in Angus cattle in Canada. It has also been reported by American research workers to occur in Shorthorns. (2).

The "Stumpy" type described by Baker of Nebraska (3) may be a sub-type of this group.

(b) Comprest or Compact Cattle — The latter is the form referred to most frequently in Shorthorns in the U.S.A. and is believed to have stemmed from a few herds. Animals appear to be almost normal but head, body, neck and legs are slightly shorter than in normal animals. They develop fairly well to 1 year of age and look similar to the normal animal but mature at about 2/3 normal size.

The "comprest" cattle found in the Hereford are not dwarfs but thought to be "carriers" and produce some dwarfs on mating comprest to comprest, similar in form to the "snorter" and less viable. True "comprests" are thought to be descendants of one bull, Colorado Domino 68th but other comprest-like animals have been found in the Hereford which bear no direct relationship.

(c) Miscellany — "Longheads", "Pin-heads", Midgets, etc.

Midgets are perfectly proportioned in every way but have not developed in size, and are of no particular significance.

The longheaded, slow growing types appear somewhat normal but under-developed in size. They are rather spindly in body form, long in the head and usually fine in the muzzle; legs may be crooked and they grow very slowly. They are definitely unthrifty but post mortems reveal no pathological condition as the causative agent. This is a questionable group since some may belong to other categories already mentioned.

In addition, dwarf-like forms such as "bull dogs" observed in Dexter and Holstein cattle, and "duck legged" cattle observed in the Jersey breed (4) have been mentioned from time to time by research workers.

Inheritance

Some of the animals obtained in our Manitoba studies are products of disease or faulty nutrition. Most, however, appear to be congenital dwarfs and the syndrome is likely hereditary. Most research workers believe that the "snorter" dwarf syndrome is basically conditioned by a simple recessive autosomal (not sex linked) gene. (5) (6). In other words, both parents must be "carriers" (heterozygous) but normalcy overshadows the recessive factor. A few feel that more than one factor pair is basically involved even in the "snorter" type. If the first is true, at least a factor pair or more of modifying genes is at work.

The "comprest" and "compact" types were thought originally to be due to partially dominant genes but recent research suggests they are possibly heterozygous forms of the basic factor with modifiers which produce the graded form. Not all research workers agree with this theory and on the contrary, believe that separate loci on the chromosomes are affected.

The longheaded, long legged types are a quandry. At least some have been categorized with compacts from a hereditary sense. Most of the animals sent to us in our Manitoba study are of this type.

The "midgets" or "Tom Thumbs" are

chance occurrences occurring about one in 100,000 births. All are probably not hereditary. In the Brahman breed, however, midget x midget matings produce midgets.

The Economic Problem

The concern over dwarfism arises from an economic loss. Theoretically if no culling was carried out, except the dwarfs themselves, in a herd using a sequence of carrier bulls, about 14% of the calf crop would be essentially lost for even living dwarfs are worthless on the market. The eradication of the factor is obviously necessary. But many productive *normal* sons and daughters are produced by a single carrier parent or even two carrier parents. Elimination of all relatives of dwarfs is too ruthless if it can be avoided as Baker in studying the "stumpy" type of the Shorthorn found a common ancestor in Whitehall Sultan. Similarly Prince Domino was found to be a common ancestor of the Herefords. These were such famous animals that elimination of all their descendants would riddle most purebred herds. Some method of diagnosing carriers and eliminating them from breeding herds, particularly purebred herds, must be found. Several have been investigated and generally they fall into four categories.

(a) Morphological

It was thought at an early date that there was a peculiarity in body form about "carrier" animals. Some cattlemen felt these were smaller and more compact than normal and had shorter broader heads with a pronounced bump and dished face. An instrument known as a profilometer was developed by Gregory and associates at California (2) to exaggerate the head profile on tracing paper. It was perfected for horned bulls of the Hereford breed and, except for one type of profile, shown to be satisfactory for horned Hereford bulls, 15 months and over. It has not been adapted for females (lack of data) and not universally accepted.

Various bone measurements have been taken particularly of the long canon bones of the forelegs and the lumbar vertebrae. In the latter, the majority of dwarfs show a distinct compression of the lumbar vertebrae and a straightness of line of the ventral profile as compared to the definite undulations in the "normal". A situation somewhat similar to the dwarf exists in the "carrier" but is not as extreme. The transverse processes are decidedly shortened and somewhat hooked in the dwarf as compared to the normal, while a "carrier" again lies between the two. Radiographs of 1 to 10 day old calves were fairly successful in diagnosing the "carrier" animals. (7).

(b) Physiological

Work reported from Missouri in 1956 (8) indicated that on the injection of insulin the blood sugar levels dropped much more rapidly and to a lower level in dwarfs and failed to return to normal as quickly as in normal cattle. This indicated a possible pituitary or adrenal cortical hormone response. The increase in white blood cell counts was used to measure the latter. Dwarfs responded very little. Pedigree clean animals showed a rapid and extreme response. Known "carriers" were intermediate. Our own work while not completely analyzed to date seems to support this contention. The over-lapping of individuals in the carrier group however renders the test impractical at present.

All research however presented does not entirely substantiate this report. (9). Differential counts of eosinophiles, neutrophiles and lymphocytes are also being carried out in our Manitoba studies.

(c) Pedigree

Since only 2 of 4 grand parents, 2 of 8 great grand parents and so forth, need be involved in producing a dwarf it is difficult to use pedigree initially to select dwarf free animals. As more contemporary dwarf free individuals be-

come known this method of detection will have more value.

(d) Progeny Test

Since only 1 in 4 calves of two carrier parents on the average will be dwarfs it is possible to postulate the number of matings a bull would need to "carrier" cows to check for the gene. If only 1 calf from a carrier cow was involved 75% of the carrier bulls would sire no dwarf calves. If 8 cows were used this drops to 10% and if 16 were used it drops to 1%. Even at a 1 in 100 chance of being wrong such things have happened in practice. While good, the progeny test to detect "carrier" bulls using "carrier" cows has some practical limitations. Few breeders can afford to keep a "carrier" cow herd of even 10 cows.

MANITOBA STUDY

In general it is the authors' opinion that the most practical test would be a chemical or morphological one of the blood, if it could be found. Most of our emphasis at Manitoba is on these phases. A study of the relationship of the odd forms of dwarfism to the better known "snorter" variety through the insulin shock test, skeletal differences or similarities and inter-mating known types with unknown is also an important part of our investigations.

PRATICAL CONSIDERATIONS

What sort of advice can be passed along to breeders:

1. Be wary of still-born calves.
2. Eliminate known "carrier" bulls from the herd immediately and send them to slaughter. Do not save breeding stock from "carrier" females.
3. There is no use begging the question by saying it is due to close mating, etc. Inbreeding does not cause dwarfism or any other anomaly. It only exposes more quickly what is being carried latently. Further, to say that it is due to a malfunction of some growth gland is probably true, but what causes this malfunction to occur in a population in a genetic ratio is the problem. Likely, it is the genes.

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Abstracts

Shehata, H. and Teuss, U. Virus hepatitis in ducks in Germany.

Dtsche. Tierarztl. Wochschr. 64:27, 1957. Ger. Sci. Bul. VMS No. 4:5 (1957).

A virus hepatitis of ducklings was found in Germany, fatal for 90-95% of the birds. Ducklings died 1-3 hours after symptoms appeared. Swelling of the liver was the principal change noted during post-mortem examination. Bacterial cultures were negative but transmission tests with bacteria-free suspensions of body organs reproduced the disease in ducklings. The virus was also transmitted to embryonated eggs. An immune serum was effective.

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